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THE AMERICAN SPIRIT IN EDUCATION

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LETTER OF TRANSMITTAL.

DEPARTMENT OF THE INTERIOR,
BUREAU OF EDUCATION,
Washington, D. C., March 28, 1919.

SIR: America inherited most of the content, form, and spirit of the education of its schools from Europe; but from Colonial times until now there has been an ever-increasing tendency to adapt these more closely to the needs of life in America and to the American spirit of service. This tendency has been given unusual impetus by the exigencies of war through which we have just passed and of readjustment through which we are now passing. The present and the immediate future therefore seem to offer an opportunity, which should not be neglected, to unify the life and work and education of America more completely and more vitally than has ever before been possible. The results of a study of the American spirit in education, embodied in the inclosed manuscript by Dr. C. R. Mann, of the advisory committee of the Committee on Education and Special Training of the Department of War, will, I believe, be helpful to this end. I therefore recommend that it be published as a bulletin of the Bureau of Education.

Respectfully submitted.

P. P. CLAXTON,
Commissioner.

THE SECRETARY OF THE INTERIOR.

THE AMERICAN SPIRIT IN EDUCATION.

Chapter I.

BENJAMIN FRANKLIN, THE PROPHET OF AMERICAN EDUCATION.

The sources of Benjamin Franklin's power and achievement must be traced to influences other than schooling, for he spent less than two years in the schools of Boston. His ancestors were sturdy and ingenious artisans, essentially practical in their whole view of life, and active in the literary and political affairs of their little village of Ecton, in Northamptonshire; yet keenly interested in the religious issues of their day. In short, these forbears were of the class who take the ideal world for granted and proceed in the faith of it to a conquest of the real.

Franklin's early "readiness in learning to read" together with the opinions of friends that he "would certainly make a good scholar," led his father to believe that he might be suited for the ministry. His uncle Benjamin encouraged this 8-year old lad in this idea by presenting him with several volumes of shorthand notes of sermons "as a stock to set up with." Fortunately, the family income would not permit of the expense of a training for the ministry, considering the "mean living many so educated were afterwards able to obtain," and Benjamin therefore became at the age of 10 assistant to his father in the eminently practical, if less aristocratic, trade of tallow chandler and soap boiler.

Benjamin hated this work. His father, fearing lest this great dislike for the trade might lead Benjamin to run away to sea, as his brother Josiah had done, carefully studied the boy in order to discover a trade more to his liking on land. Together they watched workmen at their work, and thus there developed in Benjamin that admiration for clever and skillful handling of tools from which he acquired the knack "to do little jobs" himself. This knack proved invaluable later when he wished to "construct little machines for his experiments while the intention of making the experiment was fresh and warm in his mind." But these trades of "joiner, bricklayer, turner, brazier, etc.," failed to stir his imagination.

"His bookish inclination" finally determined his father to make him a printer.

The father's influence was exerted not only in the selection of a trade, but in other ways as well. His concern was to create for the children a home atmosphere, which might "turn their attention to what was good, just, and prudent in the conduct of life." There was music for them in the evening, "when he played psalm tunes on his violin"; often a "sensible friend or neighbor" was invited in for meals "when some ingenious or useful topic that might tend to improve their minds" was discussed before the children. When discipline was needed he did not always resort to chastisement, but by argument convinced the boy "that nothing was useful that was not honest."

A fondness for reading developed in Benjamin at a very early age. He does not remember "when he could not read." While he was still a printer's apprentice he devoted all his spare time, especially on Sundays, to reading, and "often sat up in his room reading the greatest part of the night, when the book was borrowed in the evening and to be returned early in the morning, lest it should be missed or wanting."

The books that most impressed his youthful mind were Pilgrim's Progress, Burton's Historical Collections, Plutarch's Lives, Mather's Essays to do Good, and De Foe's Essay on Projects. The Essays to do Good discuss such topics as the occasion for doing good, the excellence of well doing, internal piety and self-examination, the duties of schoolmasters, and a society for the reformation of manners; while the highly imaginative Essay on Projects proposes reforms for the benefit of mankind in banking, insurance, pensions, highways, charities, learned societies, and the education of women.

The effects of this reading on Franklin's youthful spirit are reflected in his earliest writings, which, at the age of 16, under the assumed character of a middle-aged widow, named Silence Dogood, he contributed to his brother's newspaper. In one of these he gives expression to his boyish sentiments concerning college students and "Academical Learning" in the form of a quaint allegory which he interprets as "a lively Representation of Harvard College, etcetera." In others he discusses in a witty and satirical style the barbarous custom of denying the advantages of learning to women, the lack of poetry in New England, with a receipt to make a New England funeral elegy, the question whether a Commonwealth suffers more by hypocritical pretenders to religion or by the openly profane, and the establishment of friendly societies and pensions to ameliorate the lamentable condition of widows.

Mingled with the humor of these playful effusions runs a serious interest in the business of life—a conviction that "it is undoubtedly

the Duty of all Persons to serve the country they live in," and a resolution on his own part "to do for the future all that lies in my way for the service of my Countrymen." Thus even his earliest essays show that sense of humor and that imaginative idealism which seeks to express itself in actions useful to mankind.

These Dogood papers may well serve as models of clear and forceful English—yet they are the work of a lad of 16 who had had practically no ordinary schooling. But Franklin would not have us believe that his was a rare talent beyond the attainment of others. He tells us how his father found some of his papers and how—

> he took occasion to talk to me about the manner of my writing; observed that * * * I fell far short in elegance of expression, in method, and in perspicuity, of which he convinced me by several instances. I saw the justice of his remarks, and thence grew more attentive to the manner in writing and determined to endeavor at improvement.

Further incentive came to him from the tales overheard in his brother's printing office at the approbation given certain ingenious contributors to the New England Courant. He, too, "was excited to try his hand among them" and wrote an anonymous paper, which was tucked under the door of the printing house. It was read in the morning and he had "the exquisite pleasure of finding it met with approbation."

Thus, after he had been led by his father to recognize his shortcomings and had himself come to see that an effective style of writing was eminently worth while, he inaugurated that well-known series of experiments and exercises by which he sought to improve his English through contact with the best that has been taught and said in the world. Hence his power of expression was not a gift of the gods, which sprang full-grown from the brain of a genius, but was the result of self-imposed discipline for the satisfaction of a personal need.

Though most of his spare time was devoted to books, Franklin was no recluse. He formed close friendships with "bookish lads" and frequently tried his powers of argument with them in debate. At first he was "overbearing and rather insolent" and given to positive and dogmatic statements, a turn of mind which he "had caught by reading his father's books of dispute about religion." But a Quaker friend objected to this, and having "convinced me by mentioning several instances, I determined to cure myself of this folly." The reading of Xenophon's Memorable Things of Socrates suggested the idea of substituting for this habit of "abrupt contradiction and positive argumentation," the modest diffidence of "a humble inquirer and doubter." He found this habit very effective in dealing with men, and therefore "took a delight in it, practiced it continually" and thus acquired that power of stirring the imagination and "per-

suading men into measures that I have been from time to time engaged in promoting."

Notwithstanding his aversion to religious disputes and although the "dogmas of the Presbyterians . . . appeared to him unintelligible, and he early absented himself from the assemblies of the sect," Franklin was much impressed in his boyhood by the work of the benefit societies which Cotton Mather had established in Massachusetts. These societies met for the discussion, not of disputed doctrines, but of such questions as—

> Is there any remarkable disorder in the place that requires our endeavor for the suppression of it; and in what fair, likely way may we endeavor it? Does there appear any instance of oppression or fraudulence in the dealings of any sort of people that may call for our essays to get it rectified? Is there any matter to be humbly moved into the legislative power to be enacted into a law for public benefit?

The effect on Franklin of these discussions of the moral obligations of citizens in the practical affairs of life appears in the organization of the Junto in 1727. This club had no constitution defining its purpose and the duties of its officers. Instead there was a series of queries which each member was expected to read daily and to consider carefully, in order to be ready for discussion at the next meeting. The following are typical:

> Have you read over these queries this morning in order to consider what you might have to offer the Junto touching any one of them? Viz:
>
> Have you met with anything in the author you last read, remarkable or suitable to be communicated to the Junto, particularly in History, morality, poetry, physic, travels, mechanic arts, or other parts of knowledge?
>
> Have you lately heard of any citizens thriving well, and by what means?
>
> What happy effects of temperance, of prudence, of moderation, or any other virtue have you lately observed or heard?
>
> Have you, or any of your acquaintance, been lately sick or wounded? If so, what remedies were used, and what were their effects?
>
> Do you think of anything at present in which the Junto may be serviceable to mankind, to their country, to their friends, or to themselves?
>
> Have you lately observed any defect in the laws of your country, of which it would be proper to move the legislature for an amendment? or do you know of any beneficial law that is wanting?
>
> Have you lately observed any encroachment on the just liberties of the people?

These general queries were designed to stimulate the members to formulate specific topics for discussion, since—

> the rules required that every member, in his turn, should produce one or more queries on any point of morals, politics, or natural philosophy, to be discussed by the company, and once in three months produce and read an essay of his own writing, on any subject he pleased. Our debates were to be conducted in the sincere spirit of inquiry after truth, without fondness for dispute, or desire of victory.

So great was the vitality of this organization that it continued its activity for more than 40 years and—

was the best school of philosophy, morality, and politics that then existed in the province; for our queries, which were read the week preceding their discussion, put us upon reading with attention upon the several subjects, that we might speak more to the purpose; and here, too, we acquired better habits of conversation, everything being studied in our rules which might prevent our disgusting each other.

In the preparation of their papers for the Junto, the boys had great difficulty in securing books. At Franklin's suggestion they "clubbed their books to a common library" so that each might have the benefits of all. From this it was but a short step to his "first project of a public nature, that for a subscription library." This "mother of all the North American subscription libraries" spread its influence in the colonies and was the means of making "the common tradesmen and farmers as intelligent as most gentlemen in other countries, and perhaps contributed in some degree to the stand so generally made throughout the colonies in defence of their privileges."

The uses of the Junto were not confined to the amusement and education of its members. It was the parent of a number of similar organizations and furnished a center from which new plans for public welfare could be initiated and disseminated. Backed by the newspaper which Franklin edited, it was instrumental in carrying into effect such useful projects as the organization of police and fire departments, of militia, of a hospital, of an academy for the education of the youth of Pennsylvania, and of a system of cleaning and paving the streets. To such an extent did Franklin become the mentor of public progress in Philadelphia that "there was no such thing as carrying a public spirited project through, without my being concerned in it."

Franklin devoted only his spare time to these enterprises for the public welfare; but this wise use of his overtime resulted in public benefit and also strengthened and built up his own business which was that of a printer. In this capacity he published a newspaper which contained real news, and discussed morality and other matters of public interest. He made the paper pay by means of his original system of business advertisements. His Almanack, for 25 years the most widely read publication in America, was filled with "proverbial sentences, chiefly such as inculcated industry and frugality as a means of procuring wealth and thereby securing virtue." "I endeavored to make it both entertaining and useful, and it accordingly came to be in such demand that I reaped considerable profit from it."

In 1737 Franklin was appointed deputy postmaster of Philadelphia, a position which he found "to be of great advantage; for,

though the salary was small, it facilitated the correspondence that improved my newspaper, increased the number demanded as well as the advertisements to be inserted, so that it came to afford me a considerable income." Later, as Postmaster General of the Colonies, he reformed the whole postal service of the country, so that for the first time it yielded a revenue to the Crown. In time he was displaced by a "freak of the ministers" and "since that imprudent transaction they have received from it—not one farthing!"

Not only was Franklin a very practical business man, but he successfully advertised the reasons for business success through the sayings of Poor Richard: "Honesty is the best Policy; Drive thy Business, let not that drive Thee; Many Words will not fill a Bushel; a small Leak will sink a great Ship; he that lives upon Hope will die fasting; a Ploughman on his Legs is higher than a Gentleman on his Knees." Many of these "gleanings from the Sense of All Ages and Nations" were published in 1757 in a pamphlet called "The Way to Wealth" which Franklin modestly says "some thought had its share of influence in producing that growing plenty of money which was observable for several years after its publication."

The influence of Franklin on the economics of the country did not end in Poor Richard's injunctions to the people. In 1729 he published a "Modest Inquiry into the Nature and Necessity of a Paper Currency" in which he concludes that "the riches of a country are to be valued by the quantity of labor its inhabitants are able to purchase." This idea that labor is the measure and the creator of wealth was elaborated 46 years later by Adam Smith in the Wealth of Nations.

The autobiography makes little mention either of Franklin's scientific work or of his extensive correspondence on questions of electricity, meteorology, and medicine. These seem to have been to him merely amusements with which to beguile the time not devoted to his trade or to his labors in the service of his fellow men. Yet his experiment with the kite is perhaps the finest example of that imagination and fearless faith which are the motive power of science. His experiments won him recognition as a leader among his scientific contemporaries and his theory of electricity is prominent to-day in the discussions that have sprung from the recent discoveries in physics. The American Philosophical Society, which he established in 1744 for the purpose of making a cooperative attack on the scientific problems that perplexed him, is still in a flourishing condition.

It was fortunate for the colonies that they had a man like Franklin to represent them at the court of France during the American Revolution. His integrity, courage, and resourcefulness; his commonsense judgment, and scientific attitude of mind; his humor, love of

service and deep understanding of men; and his practical business sense all combined to make him win the adoration of the French people. He became to them a personification of the American spirit of liberty, equality, and fraternity.

Early in life Franklin "conceived the bold and arduous project of arriving at moral perfection." To attain this end he inaugurated a definite campaign for the acquisition of the 13 virtues that "occurred to me as necessary or desirable." But the scheme could not for long be confined in its operation to Franklin alone and accordingly he purposed writing "the Art of Virtue," not a "mere exhortation to be good, that does not instruct and indicate the means" but designed to show "the means and manner of obtaining virtue." The plan never was realized, as the "project required the whole man to execute, and an unforseen succession of employs prevented my attending to it." "But though I never arrived at the perfection I had been so anxious at attaining, yet I was by the endeavor a better and a happier man than I otherwise should have been."

His religion was broadly human, embracing the good in all sects. He was intolerant of the discourses of the minister whose aim seemed to be "rather to make us Presbyterians than good citizens." To him the day's work was the basis of religion, the workshop the temple of God, and—

> God Himself a Mechanic, the greatest in the Universe; and He is respected and admired more for the Variety, Ingenuity and Utility of His Handyworks, than for the Antiquity of His Family. . . . The Scriptures assure me that at the last day we shall not be examined what we thought, but what we did; and our recommendation will not be that we said, "Lord, Lord!" but that we did good to our fellow creatures.

Franklin's idea on education are expressed in his two papers that deal with the English Academy in Philadelphia. In the first of these, published in 1749, he advocates the establishment of a school in which the chief subjects of instruction shall be English, arithmetic, geometry, astronomy, and history—"those things that are likely to be most useful and most ornamental; regard being had to the several professions for which they are intended."

These subjects should not, however, be treated in the ordinary didactic manner; for—

> if History is made a constant part of their reading, may not almost all kinds of useful knowledge be that way introduced to advantage, and with pleasure to the students. As Geography, by reading with maps, and being required to point out the places where the greatest actions were done. Ancient Customs, religious and civil, being frequently mentioned in history will give occasion for explaining them. Morality, by making continual observation on the causes of the rise and fall of any man's character, fortune and power mentioned in history. Indeed, the general natural tendency of reading good history must be to fix in the minds of the youth deep impresssions of the beauty and usefulness of virtue of all kinds, public spirit and fortitude.

The history of commerce, of the invention of arts, rise of manufacture, progress of trade, change of its seats, with the reasons and causes, may also be made entertaining to youth, and will be useful to all. And this, with the accounts of the prodigious force and effect of engines and machines used in war will naturally introduce a desire to be instructed in mechanics, and to be informed of the principles of that art by which weak men perform such wonders, labor is saved, and manufactures expedited.

The idea of what is true merit should also be often presented to youth, explained and impressed on their minds, as consisting in an inclination, joined with an ability, to serve mankind, one's country, friends, and family; which ability is, with the blessing of God, to be acquired or greatly increased by true learning; and should, indeed, be the great aim and end of all learning.

That this plan of Franklin's was far ahead of its time is evidenced by the opposition which it aroused. In his second paper on the Academy in 1789 he tells us that "the Latinists were combined to decry the English school as useless. It was without example, they said, as indeed they still say, that a school for teaching the vulgar tongue, and the sciences in that tongue, was ever joined with a college." As a result of this "unaccountable prejudice in favor of ancient customs," Franklin concludes that "wishing as much good to the Latinists as their system can honestly procure for them, we now demand a separation" in order "to execute the plan they have so long defeated, and afford the public the means of a complete English Education."

The subsequent sections of this little book indicate how completely Franklin's own development and his writings portray the kind of education required to satisfy the national intuitions and instincts. He may justly be regarded as the prophet of American education and deserves a leading place among American educators. The wonder is that a century and a half elapsed after his lucid exposition of the subject before the country at large could rid itself of its ancient traditions and give unquestioned moral support and social sanction to his sane and sensible precepts and conclusions.

Chapter II.

THE APPRENTICE DAYS.

Public responsibility for industrial education was first publicly recognized in the poor laws of the Elizabethan age. During the reign of Queen Elizabeth about half the population of England were vagabonds. After repeated attempts to suppress vagabondage by force had failed, Parliament, in 1553, authorized the overseers of the poor to call for voluntary contributions from the rich for the purpose of placing the children of the poor in apprenticeships where they might learn a trade and thus become self-supporting. Evidently, the charitable contributions of the rich were not adequate to the requirements, for the legislation was gradually made more compelling until, in 1601, it was voted to raise the required funds by compulsory assessments of all ratable persons.

This idea of taxation for the purpose of training poor children so that they might become economically productive is expressed in several of the earliest education acts in the various colonies. Even before turning their attention to schools, the General Court of Massachusetts (1640) directed the magistrates to further the growing of flax and to consider "what course may be taken for teaching the boys and girls in all townes the spinning of yarn." In 1642, the same court, impressed by "the great neglect of many parents and masters in training up their children in learning and labor, and other employments which may be profitable to the commonwealth," ordered and decreed that in every town "the chosen men appointed for managing the prudential affairs of the same shall have the power to take account from time to time of all parents and masters, and of their children, concerning their calling and employment of their children, especially of their ability to read and understand the principles of religion and the capital laws of this country; and they shall have power to put forth as apprentices the children of such as they shall (find) not to be able and fit to employ and bring them up. They are to take care of such as are set to keep cattle be set to some other employment withal, as spinning upon the rock, knitting, weaving tape, etc. They are also to provide that a sufficient quantity of materials, as hemp, flax, etc., may be raised in their several townes, and tools and implements provided for working out the same."

The act of 1647 completes the legal foundation of the public schools of Massachusetts.

It being one chiefe project of that ould deluder Satan to keepe men from the knowledge of the Scriptures [and] that learning may not be buried in the grave of our fathers in the church and commonwealth . . . it is therefore ordered, that every towneship in this jurisdiction, after the Lord hath increased them to the number of 50 householder, shall then forthwith appoint one within their towne to teach all such children as shall resort to him to write and reade, whose wages shall be paid either by the parents or masters of such children, or by the inhabitants in general by way of supply, as the major part of those that order the prudentials of the towne shall appoint; . . . and it is further ordered, that where any towne shall increase to the number of 100 families or householder, they shall set up a grammer schoole, the master thereof being able to instruct youth so farr as they may be fited for the university.

The case of Massachusetts is typical of the general attitude throughout the colonies. In Virginia and Pennsylvania this same conviction that public education should include training for a gainful occupation finds expression in the early legislation. Thus in Virginia the act of 1660 says:

To avoid sloth and idleness . . . as also for the relief of parents whose poverty extends not to giving (their children) breeding . . . the justices of the peace should . . . bind out children to tradesmen or husbandmen to be brought up in some good and lawful calling.

In Pennsylvania, 1683, the provincial assembly provided—

that all persons in this province and territories thereof having children, and all guardians and trustees of orphans, shall cause such to be instructed in reading and writing so that they may be able to read the Scriptures and to write by the time they attain to 12 years of age, and that they be taught some useful trade or skill.

While this legislation was designed primarily to better the condition of the poor that they might not be a burden on the community, it helped to foster that sense of social distinction which has caused many to ignore the educational value of the practical arts and to overrate the educational value of the humanities. The real dignity, value, and educational importance of the practical arts were clearly seen by the prophets of America. William Penn, in 1693, wrote:

The World . . . ought to be the Subject of the Education of our Youth, who, at Twenty, when they should be fit for Business, know little or nothing of it. We are in Pain to make them Scholars but not Men! To talk, rather than to know, which is true Canting; . . . to know Grammar and Rhetorick, and a strange Tongue or two, that it is ten to one may never be useful to them; Leaving their natural Genius to Mechanical and Physical, or natural Knowledge uncultivated and neglected; which would be of exceeding Use and Pleasure to them through the whole course of their life.

From these facts it appears that in the minds of the founders of the public schools the expenditure of public funds for education was

justified not because it produced a "general diffusion of wisdom, knowledge, and virtue among the people," but because it was intended to secure four concrete ends of great value to the "Church and the Commonwealth." These were, for the church, that every one must (1) learn to read the Scriptures and the catechism; and (2) have the free opportunity of entering the ministry through the grammar school and the college; for the Commonwealth, that every citizen should learn , (3) the capital laws of the colony; and (4) some gainful occupation.

At the time that this legislation was enacted the only occupations open to graduates of the college were those of minister, teacher, and gentleman. The great majority of the people, including physicians and lawyers, learned their trades by the apprenticeship system. Therefore the responsibility for their education was divided between the schoolmaster and the master of apprentices. The schoolmaster was "to teach all such children as may resort to him to write and reade;" and be "able to instruct youth so farr as they may be fited for the university." The master of apprentices was to train them "in some honest lawful calling, labour or imployment, either in husbandry or some other trade profitable for themselves and the Commonwealth."

This division of the functions of education between the schoolmasters and the masters of apprentices was inevitable under the social and industrial conditions which prevailed in the colonies. In time, however, schools came to be regarded as constituting the whole educational system, and the fact that the training of everyone to some "gainful occupation" is one of the important justifications of taxation for public education was forgotten.

The records of the Court of Massachusetts show that great difficulty was experienced in enforcing the legislation with regard to grammar schools. Though the fine for noncompliance was increased from £5 in 1647 to £40 per year in 1718, many towns preferred to pay the fine rather than maintain such a school.

In the meantime, industry continued to flourish. The American weavers of woolen cloth had become by 1690 such successful rivals of the British weavers that Parliament in 1699 passed the woolen act which forbade the colonists from transporting woolen goods from one place to another for the purpose of sale.

In 1718 a great stir was created in the town [Boston] by the arrival of a number of Irish spinners and weavers, bringing the implements of their craft. Directly the spinning craze took possession of the town and the women, young and old, high and low, rich and poor, flocked into the spinning school which was set up on the common in the open air. Prizes were offered for the best work and the enthusiasts went about proudly clothed in the homespun products of their own hands.

The first tannery was erected at Lynn in 1629 and in 1640 the General Court of Massachusetts appointed leather searchers in every town to see to it that "such hides and skins as by casualty or slaughter come to hand" were sent to the tannery. By 1650 Massachusetts was manufacturing shoes for the other colonies.

A smelting furnace was built at Lynn in 1643 by John Winthrop. Here important improvements in the manufacture of scythes and sawmill machinery were made. The General Court of Massachusetts granted Winthrop 3,000 acres to encourage his enterprise. In Connecticut all persons engaged in iron works were exempted from taxation. In 1719 the Maryland Assembly offered 100 acres of land to any citizen who would set up iron furnaces and forges in the Province. These industries developed so well that in 1750 Parliament ordered that "no mill or other engine for slitting or rolling of iron, no plating forge to work with a tilthammer and no furnace for making steel" should be erected "in any of His Majesty's Colonies in America."

These efforts on the part of Parliament to exterminate American industries in the interests of British manufacturers deterred but they could not check the growing interest of the colonists in useful arts. A special town meeting was held in Boston at the town house September 28, 1720, at which it was voted "that the Town will proceed to the choyce of a committee to consider about promoting of a Spinning School or schools for the instruction of the children of this town in Spinning." This committee recommended the erection of a suitable house and the employment of a weaver "having a wife that can instruct children in spinning flax, to take care of the school." This project was revived in 1751 when there was organized in Boston a Society for Encouraging Industry and the Employment of the Poor. Its avowed purpose was to foster the growing of flax and the manufacture of linen to be used for export to pay for imports of woolen goods. In 1755 the General Court of Massachusetts ordered—

> that a tax be levied on every Coach, Chariot, Chaise, Calash, and Chair within the Province to be paid by the owner thereof annually, except the Governor, Lieutenant Governor, the President of Harvard College and the settled ministers throughout the Province, and that the money so raised should be applied to the purchasing a suitable house, within the town of Boston, for carrying on the business of spinning, weaving, and other parts of linen manufacture.

Fifteen hundred pounds were raised by this means and a manufactory house was built on Long Acre Street (now Tremont Street) where linens were produced and instruction given in spinning and weaving.

In New York a Society for the Promotion of Arts, Agriculture, and Economy was established (1764) for the purpose of—

encouraging to the utmost the manufacture of linen, which it is hoped to establish on a most solid foundation and thereby to increase the value of land, give employment to the poor, and save the public large sums of money and heavy debts for English goods.

The Stamp Act (1763) and the War of the Revolution gave impetus to the movement for goods "made in America." The Daughters of Liberty resolved to buy no more British goods and to wear only homespun; and the seniors in Harvard College agreed to take their degrees (1768) "dressed altogether in the manufactures of this country."

It is a well-recognized fact that the efforts of the British to crush American manufacturing industries were among the chief causes of the Revolutionary War. The only positive action of the first Continental Congress (1774) was its nonimportation agreement which they well knew would strike the British in a vital spot. This agreement was enforced with such fidelity that clothing, gunpowder, iron ware, and other necessities soon became scarce. Thereupon, Congress, in 1776—

Resolved, That it be recommended to the said Assemblies, Conventions, and Councils or Committees of Safety, that they take the earliest measures for erecting and establishing in each and every Colony, a Society for the improvement of Agriculture, Arts, Manufactures, and Commerce, and to maintain a Correspondence between such Societies that the rich and numerous natural advantages of this country for supporting its inhabitants, may not be neglected.

After the Peace of Paris, under the Confederation, each colony controlled its own trade. Because there was thus no concerted action with regard to industrial protection, England was able to flood the American markets with foreign goods which were sold at prices with which home manufactures could not compete. American industry was paralyzed, money became scarce, and the workingmen were idle.

To meet this situation, many societies were organized by voluntary action of "patriotic citizens for the promotion of the useful arts." Thus in Philadelphia the Society for the Promotion of Agriculture was founded in 1785. That same year a similar society was incorporated in South Carolina for the purpose of maintaining an experimental farm. The Society of Mechanics and Tradesmen in New York, though organized at this time mainly as a mutual benefit society, became prominent later because of its library and its school, which are still rendering valuable service. The Tammany Society, "a goodly company of consociate brethren, well skilled in the mechanic arts," was chartered in 1789 and was primarily intended to

foster industrial interests in opposition to the military order of Cincinnatus.

The leaders in these associations were men like Robert Livingston, American ambassador to France; DeWitt Clinton, governor of New York; Samuel DeWitt, surveyor general of New York; and Stephen van Rensselaer. Two college professors were also members of the New York Society. The subjects discussed at their meetings covered a wide range, e. g., methods of fertilization, experiments in growing corn, a proposed system of national standards of weights and measures, etc.

In 1787, the Boston Association of Mechanics and Tradesmen, in a patriotic effort to protect and develop home industries, sent a circular letter to other similar associations urging cooperation. These associations took an active part in the struggle for the ratification of the Constitution. "But for the firm belief and ardent hope that the Federal Constitution would protect and encourage the manufactures of the United States, it would never have been adopted." In this they were not disappointed, for the first act of the consolidated government (1789) was a statute for the joint purposes of "raising revenue and protecting manufactures by laying duties on goods, wares, and merchandise imported." The first Federal patent law was passed in 1790.

The ratification of the Constitution, the funding of the national debt, and the establishment of a national banking system furnished a safe basis for industrial development. These fiscal measures also supplied a powerful economic motive for the maintenance of national unity.

Hamilton's Report on Manufactures (1791) urged that a Federal Board for Promoting Arts, Agriculture, Manufactures and Commerce be created to encourage by rewards and lucrative premiums, the introduction of useful discoveries, inventions and improvements and to pay the expenses of immigration of artists and manufacturers in important branches of industry. The Federal board was never appointed, but the report had an immediate effect. In 1791, the Philadelphia Society for the Promotion of Agriculture offered prizes for the best farm products. A bill was introduced into the legislature of Pennsylvania (1798) levying a public tax of $50 for each member of the legislature, the money thus collected to be offered as rewards for "such articles of Agricultural Production or improvements in Manufactures, or the useful Arts . . . as they shall think will be beneficial to the country." The bill was not passed until 1820. The legislature of New York State began lending money to individuals to enable them to establish and carry on manufactures, and in 1808 passed an act granting premiums for the best specimens of woolen cloth manufactured in the State.

President Washington added his voice to the encouragement of the movement, at least as far as agriculture was concerned, in his final message to Congress, December 7, 1796.

> Institutions for promoting it (agriculture) grow up, supported by the public purse; and to what object can it be dedicated with greater propriety? Among the means which have been employed to this end, none have been attended with greater success than the establishment of Boards, composed of proper characters, charged with collecting and diffusing information and enabled by premiums and small pecuniary aids to assist a spirit of discovery and improvement. This species of establishment contributes doubly to the increase of improvement, by stimulating to enterprise and experiment, and by drawing to a common center the results everywhere of individual skill and observation and spreading them thence over the whole nation. Experience accordingly has shown that they are very cheap instruments of immense national benefits.

The committee to whom this suggestion of "the farmer of Mount Vernon" was referred, reported on January 11, 1797, that the best way to promote agriculture was to excite among the farmers a spirit of enquiry, industry and experiment; and that this could best be done by establishing societies for the promotion of agriculture and internal improvements; because such societies supplied the farmers with the easiest means of acquiring needed information and compelled them to get acquainted with one another. A bill was reported which proposed the establishment at Washington of a National Agricultural Society. Thirty delegates elected by the society should constitute a National Board of Agriculture with a permanent secretary and free postage for its mail. The bill was referred to the committee of the whole and forgotten.

From the foregoing it appears that the eighteenth century was characterized by a gradual development of industrial production accompanied by a widespread discussion of ways and means of enlightening workers and encouraging them to increase production. The net result of this discussion was to make clear that the needs of the situation were the dissemination of information, the fostering of mutual acqaintance and the encouragement of a spirit of enquiry, industry and experiment. No tangible results were accomplished in the way of furnishing facilities for meeting these needs beyond the organization of societies where these matters were discussed. The century was thus a period of incubation of ideas which soon began to express themselves in material form.

Chapter III.

JOURNEYMAN'S ESTATE.

Early in the nineteenth century the ideals of vocational education began to take material form. In 1796 the Massachusetts Agricultural Society began to publish its proceedings which developed in 1814 into the Massachusetts Agricultural Repository and Journal. The first volume of the transactions of the New York Society for the Promotion of Useful Arts appeared in 1801. For some years these associations published frequent notices and reports in the daily papers. As the demand for technical knowledge increased, trade journals were established. The American Farmer was founded in Baltimore in 1819. The New England Farmer (Boston, 1823), the Country Gentlemean (Albany, 1834), the American Cultivator (Boston, 1839), the American Agriculturist (New York, 1842), and the Scientific American (New York, 1845), are still meeting the need that brought them into being.

That the demand for general enlightenment was also increasing is evident from the development of newspapers and periodicals. In 1689 the only paper in America appeared monthly, "thirteen months behind with the news beyond Great Britain." The eagerness of the people for information made possible the Daily Advertiser of Benjamin Franklin Bache in 1784. By reducing the price to one cent the New York Sun, in 1833, brought the daily newspaper within the reach of all. Now more than 2,500 dailies and 20,000 weekly and monthly periodicals are published regularly in the United States alone.

In 1810, another project for educating the people was inaugurated by Elkanah Watson in Pittsfield, Mass. He exhibited a pair of imported merino sheep in the market place and found that they were the objects of much interest and discussion. This led him to organize an idustrial exhibition, where country folk might study the best products of the State and learn of new labor-saving inventions and methods of cultivation. The venture proved a great success. More than 2,000 attended and the educational value was so evident that Watson appealed to John Adams to help him secure funds to finance other projects of the same sort. But evidently the "Father of the public schools" saw little educational worth in a festival which so

little resembled a conventional school, but he replied: "You will get no aid from Boston; commerce, literature, theology, medicine, the university, and universal politics are against you." In spite of the weight of this opposition to the county fairs, they soon became the most important annual event in every community. In time the idea extended to such exhibitions as those of the American Institute (incorporated in New York in 1828), and of the national and State agricultural societies. The Centennial Exhibition of 1876, the first international fair held in the United States, was attended by 9,892,625. The Panama-Pacific Exposition of 1915 had 18,871,957 paid admissions. Who shall say which has contributed more to the enlightenment of the American people—these county, State, national, and international exhibitions, or the "literature, theology, medicine, university, and universal politics" that were against them?

Along with this growing enlightenment of the colonists came the gradual recognition of the fact that industrial independence could be secured only through an industrial efficiency comparable with that of the foreign manufacturers. At this time the use of machinery and the factory system had progressed much further in England than it had here, and this gave the mother country an advantage, which she sought to retain by forbidding the exportation of machinery and the emigration of skilled workmen to America. Therefore, in 1788, Tench Coxe, a manufacturer of Philadelphia, at his own risk and expense, made a contract with an English mechanic resident in Philadelphia to return to his native country and secure brass models of the Arkwright machines. The models were to be sent to France and reshipped, with the cooperation of Thomas Jefferson, then American minister in Paris. The attempt failed; the models were seized and the agent arrested. Thereupon Mr. Coxe inserted an advertisement in a Philadelphia paper offering a reward for the introduction in this country of improved cotton machinery. This advertisement attracted the attention of Samuel Slater, who had worked in the Arkwright factory.

Disguised as a sailor Slater escaped to America, where he succeeded in making from memory satisfactory reproductions of the foreign models. The "old mill" which he established at Pawtucket in 1790 was the first successful textile mill driven by water power in America. The enterprise paid from the start, improvements followed one another in rapid succession, and the manufacture of cotton cloth was soon on a firm basis.

The invention of the cotton gin by Eli Whitney in 1793 gave further impetus to the textile industry and was the means of making cotton growing the chief industry of the South. Steam was first used as the motive power for textile mills in 1810.

In other industries the spirit of invention was active. Oliver Evans devised the first machinery for flour mills in 1787. Among the patents issued in 1790 was one for nail-making machinery. In 1791 machinery for thrashing grain was patented. Nicholas I. Rooseveldt built a double steam pump with a capacity of 3,000,000 gallons a day for the Philadelphia water works in 1800. The first high-pressure steam engine of Oliver Evans appeared in 1801. Six years later Fulton made his famous trip up the Hudson in the *Clermont*. When anthracite coal was discovered it was considered good for nothing but gravel footwalks, until 1812, when Joseph Smith, the inventor of the iron plowshare, thought of burning it over a grate, which made possible a stronger draft. Among other interesting patents of the period may be mentioned the screw propeller (1807), soda water (1807), the hot-air furnace (1808), and metal pens (1810).

In 1816 a committee of Congress urged the establishment of a national university, on the ground that "if American invention, unassisted, as it has been, already excites the astonishment of Europe, what may not be expected from it when encouraged?"

The War of 1812 was caused mainly by England's efforts to control American trade in the interests of British manufacturers. The embargo and the nonintercourse act, however, gave the domestic manufacturers a virtual monopoly of the home market for a period of seven years. This threw the country on its own resources, and, since commerce was crippled, turned the attention of all to the development of home industries. The effect may be seen in the textile industry, for example, where the number of spindles in cotton mills increased from 8,000 in 1807 to 500,000 in 1815 and the number of employees from 8,000 in 1811 to 76,000 in 1815.

The development of industries made transportation routes necessary. William Penn in 1690 proposed joining the Schuylkill and Susquehanna Rivers by a canal. Work was finally begun in 1793 and completed in 1827, in time to compete with the railroad. The Santee Canal in South Carolina was begun in 1786 and finished in 1800. The Middlessex Canal, joining Boston with the Merrimac, was building from 1793 to 1803. These early canals were the work of foreign engineers.

Albert Gallatin, Secretary of the Treasury under Jefferson, published an elaborate plan for national roads and canals in 1808, but the project was frustrated by the war with England. The Erie Canal, the first great pioneer work of American engineering, was built 1817–1825. By it the time from Albany to Buffalo, a distance of 363 miles, was reduced from 20 to 10 days. It was executed by three American judges—James Geddes, Benjamin Wright, and Charles Brodhead—who had had no formal technical training.

They felt their way along, working out each problem as it came with energy and determination. What they did not understand, they conquered by diligent study, unwearied zeal, and sound common sense. By the constant exercise of these qualities they laid the foundations of the profession of civil engineering in the United States.

This industrial activity was accompanied by an ever-increasing demand for further enlightenment concerning applied science and for better practical training for workers. State legislatures and the Federal Congress, however, were slow to recognize their responsibility in this matter. Washington's proposal for a national board of agriculture received but scant attention in Congress. In the Pennsylvania Legislature a bill to give a State subsidy to county agricultural societies had lain on the table since 1798. In 1817 a bill was introduced into Congress authorizing the establishment of a national board of agriculture with distinctly educative powers, but Congress failed to pass it. The next year the Columbian Institution for the Promotion of the Arts and Sciences was organized at Washington by voluntary action of interested citizens for the purpose of collecting products of various kinds, of publishing discoveries, of gathering information concerning geology and agriculture, and of keeping a statistical history of various localities as to products, imports, and exports, and of publishing an annual report on these subjects.

The first State to recognize its obligation to assist in the practical education of artisans was New York. In 1819 the legislature at Albany appropriated $10,000 a year for the support of county societies for the promotion of agriculture and domestic manufactures. Similar legislation was passed in Pennsylvania in 1820. These efforts did not, however, satisfy the growing demand, and in 1823 Jesse Buel, chairman of the committee on agriculture of the New York State Legislatire, reported a bill calling for the establishment, at public expense, of a State school of agriculture.

This report begins by saying that since agriculture is the basis of all industry, it should be elevated to the rank of a liberal and fashionable study. This can be done with the help of science. Such a school should consist of: (1) a pattern farm; (2) an experimental farm; (3) a manufactory of implements; (4) a school of industry where the poor may receive a good education in agriculture and mechanic arts; (5) a boarding school for children of affluence; (6) an institution of agriculture, theoretical and practical.

Such a school would be of great benefit (1) to agriculture; (2) to commerce and manufactures, because of increased products of agriculture; (3) to the morale of society, because ideals of industry and sobriety would be fostered; (4) to the State revenues, because of increased canal tolls; and (5) to political institutions, because intelli-

gent farmers are the best citizens. Such a school is not a utopian dream since one has been conducted for a number of years with great success by von Fellenberg at Hofwyl in Switzerland. The conditions here assure us that a school of this type would meet the needs of America.

The interest in this report centers about the fact that it describes so clearly the kind of school that seemed to be needed in the country at that time. The Fellenberg school at Hofwyl, which is here mentioned as the best model to follow, derived its methods from Pestalozzi, whose educational principles are these: 1. An all-round training must be given. 2. The nature of the pupil must determine all the details of his education. 3. "Work in general is the surest of all exercises for the attention, and man is much more truly educated through that which he does than through that which he memorizes." Knowledge without the ability to apply it is a "fearful lot for a human being." 4. The method of learning must primarily be based upon the analysis of experience. "Put the student on the road which the discoverer of the subject himself took and had to take." 5. "We get our knowledge by our own investigation and not by endless talk about the results of art and science." 6. Organization and correlation of experiences are necessary.

The Buel report closes with the words: "The Honorable Stephen van Rensselaer has offered a gratuitous deed of lands required for the use of the institution." The State legislature was, however, not yet ready to take so progressive a step, and the proposed bill was not passed. The next year van Rensselaer wrote to the Rev. Samuel Blatchford:

> I have established a school at the north end of Troy . . . for the purpose of instructing persons who may choose to apply themselves in the application of science to the common purposes of life. My principal object is to qualify teachers for instructing the sons and daughters of farmers and mechanics . . . in the application of experimental chemistry, philosophy, and natural history to agriculture, domestic economy, the arts, and manufactures. From the trials which have been made by persons in my employment . . . I am inclined to believe that competent instructors may be produced in the school at Troy, who will be highly useful to the community in the diffusion of a very useful kind of knowledge, with its application to the business of living. Apparatus for the necessary experiments has been so simplified . . . that but a small sum is now required as an outfit for an instructor in the proposed branch of science; consequently every school district may have the benefit of such a course of instruction about once in two or three years, as soon as we can furnish a sufficient number of teachers. I prefer this plan to the endowment of a single public institution, for the resort of those only whose parents are able and willing to send their children from home or to enter them for several years, upon the Fellenberg plan. It seems to comport better with the habits of our citizens and the genius of our Government to place the advantages of useful improvement within the reach of all.

The founder also directed—

that with the consent of the proprietors, a number of well-cultivated farms and workshops in the vicinity of the school be entered on the records of the school as places of scholastic exercise for students, where the application of the sciences may be most conveniently taught.

The details of organization of the school were entrusted to Amos Eaton, a graduate of Williams College who had done graduate work in science under Silliman at Yale. The methods which he employed differed from those of other schools in three important ways:

(1) The pupil is given the place of the teacher in all his exercises. Being under the necessity of relying upon his own resources and of making every subject his own, he becomes an adept as a matter of necessity. (2) In every branch of learning the student begins with its practical application, and is introduced to a knowledge of elementary principles from time to time as his progress requires. By this method a strong desire to study an elementary principle is excited by bringing his labors to a point where he perceives the necessity of it, and its direct application to a useful purpose. (3) Corporal exercise is not only necessary for the health of students, but for qualifying them for the business of life. . . . Such exercise as running, jumping, climbing, scuffling and the like are calculated to detract from that dignity of deportment which becomes a man of science. Therefore . . . such exercises as land surveying, general engineering, . . . examining workshops and factories, watching the progress of agricultural operations . . . are made the duties of students for a stated number of hours on each day.

Prof. Eaton was always very insistent that this method of instruction was—

not Fellenbergian, nor Lancastrian, but purely Rensselaerean. The Rensselaerean scheme for communicating scientific knowledge had never been attempted on either continent until it was instituted at this school, two years ago. Many indeed mistook it, at first, for Fellenberg's method; but its great superiority has now been satisfactorily tested by its effects.

It is perfectly clear that the Rensselaerean method, with its marked emphasis on motivated self-activity in achieving the mastery of things, was very different from the method in common use in the schools and colleges, with its enforced repetition of words and phrases. A careful analysis shows, however, that it differed from the method of Fellenberg only in the means that were employed to attain the ends described by the educational principles of Pestalozzi. Both aimed to give an all-round training in harmony with the nature of the student. Both sought to accomplish this by practical analysis of experience, personal investigation, and correlation. Both were thus striving, each in its own way, to give concrete expression to the same ideals of education for use.

The year 1824 witnessed the inauguration of another enterprise that has been of far-reaching usefulness to technical education. Samuel V. Merrick, a young man, 21 years of age, "without a mechanical education, with scarcely a mechanical idea," became the

owner of a workshop. He realized that "without knowledge he could not succeed; and that as a mechanic he was socially degraded, for in those days people despised mere mechanics." The mechanics on the other hand, refused him membership in their mutual benefit association, because he was confessedly not a mechanic. Although in 1816 Count Rumford had endowed at Harvard a chair in "the application of science to the useful arts," and although that same year the University of Pennsylvania had "created a new department to be devoted to the study of natural science," Merrick was unable to get the kind of instruction he needed.

In this dilemma he decided to establish a new institution that would meet his own needs. A similar effort had been made the previous year by Prof. Keating, who held the newly established chair of "chemistry in its application to agriculture and the mechanic arts" at the University of Pennsylvania; but this effort had failed. Fortunately, Keating and Merrick combined forces, and this combination of Merrick's need with Keating's knowledge proved effective. The Franklin Institute began its long career of usefulness. One of its first students, a bricklayer named Thomas U. Walter, became architect of the dome of the Capitol at Washington. Merrick himself became the first president of the Pennsylvania Railroad.

The objects of the institute were the promotion of science and the useful arts—

First, by the delivery of lectures on the arts and the application of science to them; second, by the formation of a library of books relating to science and the useful arts, and the opening of a reading room; third, by the examination of all new inventions and discoveries by a committee of learned and honorable men; fourth, by the publication of a journal to contain essays on science and art, specifications of English and American patents, etc.; fifth, by holding exhibitions of American manufactures and awarding medals to worthy workmen; sixth, by building a hall for the meetings of the institute and the use of the members; seventh, by collecting machines, minerals, materials, etc., used in the mechanic arts; eighth, by the establishment of schools in which should be taught architecture and mechanical drawing, chemistry applied to the arts, mechanics, and, if possible, of a high school for giving young men a liberal and practical course of education.

The Journal of the Franklin Institute was started in 1826. In it were published regularly the specifications of American patents until the Patent Office commenced to issue reports. It contains the only complete list of American patents since 1825. In 1820 the Society of Mechanics and Tradesmen of New York opened its apprentice school and library. The Maryland Institute of Baltimore (1825) and the Ohio Mechanics, Institute at Cincinnati (1829) are other similar schools of this period. At this time (1827) the public schools reached the low-water mark of their efficiency, and various movements aimed at their reorganization were set on foot.

During the first 25 years of the nineteenth century progress consisted in the achievement of the ideals that developed during the previous century through trade journals and magazines, county fairs, and several schools for training in the mechanic arts. The conception that training in agriculture and the mechanic arts should be elevated to the rank of a liberal and fashionable study had also taken shape and specific suggestions as to how this might be done had been presented to a number of State legislatures in the hope of securing public support. The young Nation had also finished its apprenticeship to foreign masters and achieved industrial independence. A national individuality was beginning to appear with well-defined attitudes and interests.

Chapter IV.

INDUSTRIAL REORGANIZATION.

The first important new project that gave opportunity for free expression of the national temperament was the building of the railroad. In 1812 John Stevens, of Hoboken, the engineer whose son later founded Stevens Institute, had presented to the New York State commissioners complete and detailed specifications for building and operating a steam railroad from Albany to Buffalo. Stevens later demonstrated that his plan was practical by building a steam locomotive that carried six passengers around a circular experimental track at the rate of 12 miles per hour. But his suggestion was laughed out of court as visionary by such keen and progressive lawyers and diplomats as De Witt Clinton, Gouverneur Morris, and Robert Livingston. The Erie Canal was built and opened for traffic in 1825. Seven years later the steam locomotive "De Witt Clinton" made its celebrated trial trip over the new line from Albany to Schenectady.

The Baltimore & Ohio Railroad, incorporated in 1827, began operations with horses for motive power. The line happened to pass through some property owned by Peter Cooper, then proprietor of an iron mill near Baltimore. Cooper had a vision of what might be if steam were used in place of horses. He also realized that the success of the road meant an enhanced value for his property. With characteristic American and engineering spirit, he determined to prove that locomotives could be made to do the work. His experimental model, the "Tom Thumb," built with crude tools, with rifle barrels for fire tubes in its boiler, weighed about 1 ton and developed about 1 horsepower. On one of its early trips, while Cooper was driving it, it fell in with one of the regular trains drawn by a "splendid gray horse." A race ensued in which Cooper slowly gained the lead until the belt on the blower broke; the steam pressure fell, and the horse won. None the less, he had demonstrated that the iron horse was practicable.

The directors of the South Carolina Railroad, then building, were debating this same problem and had made estimates on the relative cost of horses and of steam. Their chief engineer, Horatio Allen, who had visited England and studied Stephenson's engines, succeeded in

convincing them that even though their own estimates were as yet inconclusive, the probability of material improvement in the horse was relatively small, while in the case of the locomotive "the end is not yet." They unanimously elected to try steam.

The building of this road was typical of all railroad building in America. It was an uncertain venture at best. In England, the railroads followed the population, and a rich traffic was waiting for them on the opening day; there the companies could afford to build straight and level tracks, regardless of expense. But in America distances were long and population scattered. Capital and confidence were scarce. Profits depended on whether or not the population would follow the road. Hence, great economy was necessary, particularly in the original costs.

Even in the face of conditions such as these, Allen believed that it would be possible to build locomotives that could climb hills and round curves with safety. When the line cut a hill he did not tunnel through it, but ran around or over it. In other words, he constructed the best line possible for the money available and then devised a locomotive that was powerful enough to master the grades and flexible enough to operate successfully on a rough and sinuous track.

Thus the problem of the railroad in America was solved by first adapting the track to the country and then adapting the engine to the track. This solution divided the responsibility between the civil and the mechanical engineer. It has been a powerful incentive to the development of the technique of road and engine building and to the growth of the professions of civil and mechanical engineering.

Many of the civil engineers who built the railroads were trained in field work on canals. Prior to 1840, Rensselaer had graduated 151 men. Of the first thousand cadets at West Point, 150 became engineers, many of whom were prominent in early railroad work. On the other hand, those who built the locomotives had no formal technical training. John Stevens and Horatio Allen were graduates of Columbia. But Peter Cooper, Phineas Davis, Ross Winans, and William Norris, who developed the motive power for the Baltimore & Ohio, and Thomas Rogers and M. W. Baldwin, heads of the locomotive works bearing their names—these men who contributed most to the development of the locomotive—were educated beyond the grammar school entirely in the school of experience. Yet so ingenious was their adaptation of means to ends that within 15 years of the first beginning they had laid the foundations of American locomotive practice. On the lines which they marked out the puffy, pokey, smoking rattletrap of 1832, whose limit was 15 tons 15 miles per hour, and whose starting "jerked the passengers from under their hats" has grown into the silent, swift, and powerful leviathan of to-day.

Although the main principles of American locomotive practice were determined by 1846, three important mechanical inventions since then have added much to the comfort and safety of travel. These are the Pullman car (1864); the Westinghouse air brake (1869); and the Hall automatic block signals (1871). Since these were all the work of men who had no formal technical schooling, it is clear that transportation by machines—the engineering achievement that lies at the basis of our whole industrial fabric—was accomplished before engineering schools had really begun to train men for the work.

The difficulties that the early builders of railroads had to overcome were not limited to the scaling of mountains and the building of tracks and locomotives. They have had to educate the educators. Thus, in 1829 the guardians of education in the persons of the school board at Lancaster, Ohio, seriously considered the propriety of using the schoolhouse for the discussion of such a question as whether the railroad was practical or not. They said:

> You are welcome to use the schoolhouse to debate all proper questions in, but such things as railroads are impossibilities and rank infidelity. There is nothing in the Word of God about them. If God had designed that His intelligent creatures should travel at the frightful speed of fifteen miles an hour, by steam, He would have clearly foretold it through His holy prophets. It is a device of Satan to lead immortal souls down to Hell.

Simultaneously with the building of the railroads, there was developing in Virginia another application of the forces of nature to the convenience of man at the hands of Cyrus Hall McCormick. The son of a farmer, with only a few years of elementary schooling, he devised and constructed in 1831 a machine that by 1860 was saving the country $55,000,000 per year. So important was this invention that the French Government decorated him as an officer of the Legion of Honor for "having done more for the cause of agriculture than any other living man."

Greater speed in harvesting made possible larger farms than could be had in the East. This made necessary the extension of the railroads and resulted in the opening of the West. The railroads were still further developed to ship the farmer's products East again. Thus the railroads followed the reaper. Together they have been the chief factors in the industrial upbuilding of the Nation. But the making of locomotives and of harvesting machinery has always been almost entirely in the hands of men who have not graduated at engineering schools.

The railroad and the reaper were, however, not the only expressions of the engineering spirit in the country. Before the Centennial Exhibition of 1876, more than 100,000 patents had been issued, and the exhibition itself bore witness to their variety and their labor-

saving utility. Among the most important may be mentioned the telegraph, by Joseph Henry and S. F. B. Morse (1842); the sewing machine, by Elias Howe (1846); the rotary printing press, by R. M. Hoe (1846); structural iron beams, by Peter Cooper (1854); the typewriter, by Charles Thurber (1843); vulcanized rubber, by Charles Goodyear (1844); passenger elevator, by E. G. Otis (1852); and the Corliss engine (1850).

These and many other less striking innovations changed the entire nature of American domestic and industrial life in the 50 years from 1820 to 1870. The revolution wrought in domestic life has been frequently described and need not here be mentioned. For this discussion the important changes were those wrought in the distribution of the workers among the various "gainful occupations of benefit to themselves and to the commonwealth." These changes are shown in the following table:

	Number of workers per 1,000.			Rate of change per 1,000 per year.		
	Agriculture.	Manufactures, trade, and transportation.	Professional and personal service.	Agriculture.	Manufactures, trade, and transportation.	Professional and personal service.
1820	830	170	.....			
1840	775	190	35	− 2.75	+1.00	.....
1870	476	314	210	−10.00	+4.13	+5.83
1910	329	482	189	− 3.68	+4.20	− .52

The above figures show clearly the acceleration which the railroads and the reaper produced in the industrial reorganization of the country. In the 20 years prior to 1840 the drift away from agriculture into other pursuits had been taking place at the rate of 2.75 per 1,000 per year. But in the next 30 years this drift was nearly four times as great. More than half of those who sought other occupations than agriculture during this period are classified in 1870 in the personal service group—domestic servants, hotel keepers, waiters, laundresses, nurses, barbers, bootblacks, and the like—a striking proof of the changes produced by machinery in the habits of domestic life. The majority of the other half entered the rapidly developing fields of manufacture, trade, and transportation.

Since 1870 the proportion of the workers engaged in the personal service group has remained constant, and the drift from agriculture to commerce and manufactures has continued at a constant average yearly rate. In other words, the general outlines of the industrial reorganization were determined before 1870. Since then the material progress of the Nation has consisted in the gradual perfection, sublimation, intensification, and expansion of the tendencies there expressed.

Up to 1870 the engineering schools of the United States had graduated less than 900 students. The census report for that year gives the number of engineers in the country as 7,374. Hence at that time certainly not more than one out of every eight practicing engineers was a college graduate. Therefore the engineering colleges exerted relatively little influence in laying the foundations and determining the general outlines of the industrial reorganization. They seem to have been the consequences rather than causes of the transformation.

Evidence of the justice of this conclusion has already been presented in the story of the founding of the societies for the promotion of useful arts and of the Franklin Institute. The proceedings of these institutions are full of discussions of the new problems that were met in the development of industrial projects. Though the solutions often strike one now as rather crude, they worked. Manufactures flourished and money became plentiful. The tariff was raised, the national debt paid, and there was a surplus in the Treasury. Congress had begun (1836) to distribute this surplus among the States for purposes of education and internal improvements when the panic of 1837 brought the financial game to a sudden halt.

On the other hand, farms continued to yield a gradually diminishing crop per acre, showing exhaustion of the soil. Twenty years before the United States had been exporting some $14,000,000 worth of breadstuffs annually, but in 1837 it was necessary to import about $8,000,000 worth. The decrease in value of farm products was estimated at 10 cents per acre per year, or about $10,000,000 per year for the whole country. Old farms in the East were being deserted either for virgin farms in the West or for manufacturing enterprises.

It is not surprising, then, that efforts to secure public support for schools of agriculture and mechanic arts were renewed at this time. In Pennsylvania the Franklin Institute presented a petition to the State legislature on December 7, 1837, praying for the establishment of a State school of practical arts. Such a school had been part of the original plan of the Institute, finances had not yet permitted of its realization. The legislature was besieged by memorials from all parts of the State urging favorable action on this petition. Similarly in New York the legislature passed an "act to incorporate the New York State Agricultural School" in 1836. The act carried with it no appropriation but left the support of the institution to private subscription. When this project failed, an "act to encourage agriculture" was introduced (1839) which carried with it an annual appropriation of $20,000 for the support of the local agricultural societies and a State board of agriculture. This act called forth a deluge of petitions in its favor from all parts of the State. None of these efforts led to the establishment of schools.

The Smithsonian bequest of $500,000 "for the increase and diffusion of knowledge among men" was accepted by Congress in 1836. To the friends of industry this seemed to offer a possibility of establishing a national agricultural school, for several memorials were sent to Congress urging the use of at least part of the fund for the "increase and diffusion of agricultural knowledge." In 1841, a national convention was called in Washington to organize the United States Agricultural Society for the purpose of securing this bequest for a "great school and library of agricultural science and experiment with a garden that should be worthy of the name of Smithson." But a committee of the House had reported in 1840—

that the declared object of the bequest of James Smithson to the United States of America being the foundation, at the City of Washington, of an establishment "for the increase and diffusion of knowledge among men," no appropriation of any part of the fund to the purpose of educating the children or youth of these United States would fulfil the intent of the testator.

The establishment of an astronomical observatory was recommended, and the United States Agricultural Society faded away.

This report was not approved by Congress and the question was referred (1846) to a new committee whose chairman, Robert Dale Owen, had been educated at the Fellenberg school at Hofwyl. This 1846 report states that "Whereas the general diffusion of knowledge may be accomplished most effectively through the common schools; and whereas knowledge may be essentially increased by scientific research and by spreading a taste for science and the arts," therefore the fund should be used to establish a school. This school should support—

a professor of agriculture, a normal department, a professor of common school instruction, and such other professors, chiefly of the more useful sciences and arts, as may be necessary for such a thorough scientific and liberal course of instruction as to qualify men for teachers of the more important branches of science.

It should not have "any school of law, medicine, or divinity, nor any professor of ancient languages." Congress, however, felt the impropriety of utilizing the bequest of a foreigner to relieve these United States of the "solemn and indisputable obligation incumbent on parents and guardians" of properly educating their children. Twenty years later the land-grant colleges were established at public expense, and their subsequent development along the lines of this report has demontrated its far-sighted wisdom.

Since Congress also believed that "the Government can not, without violating the principles on which it rests, become . . . a censor of any department of the press, an arbiter of science, or a publisher of works of mere literature or philosophy, any more than of morals or theology," the functions of the Smithsonian Institution

were finally defined in an act (1846) that was a careful compromise among the claims of a library, a museum, a research institution, and a publishing center.

While these efforts for education in agriculture and mechanic arts were making progress, another school movement with totally different aims and ideals was developing in New England. Massachusetts and Connecticut, in 1837–8, created their State boards of education and called as their respective secretaries those two notable lawyers and legislators, Horace Mann and Henry Barnard. Having "abandoned jurisprudence and betaken themselves to the larger sphere of mind and morals," these two men went enthusiastically to work to lay the foundations of our system of public schooling at public expense. Curiously enough, as has been noted, the fact that the training of every one to some "gainful occupation" is one of the important justifications of taxation for public education was forgotten. The idea legalized in 1647, that the duties of the schoolmaster were merely "to teach all such children as may resort to him to write and reade, and to instruct youth so farr as they may be fited for the university" had then become an unquestioned and unimpeachable tradition. Therefore the two movements developed independently and have seemed until very recently quite incompatible with each other.

The 20 years from 1837 to 1857—the age of the "Forty-Niner"—have been called the "Golden Age." In this brief period the total wealth of the country quadrupled, and the per capita wealth more than doubled. The Federal treasury overflowed, the tariff rates were lowered and reduced by Walker to a strict business basis, and industry flourished on every hand.

This unprecedented prosperity and expansion of the mechanic arts made the need of more definite and accurate knowledge of science so apparent that Congress began at last to recognize the demand. Thus in the early years of steam traffic there were so many disasters due to boiler explosions and fires that a Federal investigation was demanded. The report (1838) lists 256 such accidents, which had resulted in 1,704 killed and 480 injured. Profs. Silliman and Olmstead, of Yale, were consulted in the matter and an effort was made to suggest provisions for greater safety of construction. The general conclusion was that accidents were not due to faulty construction of machinery so much as to ignorance and carelessness of those in charge. This led to the establishment of the system of Federal inspection of steamboats and the licensing of masters and engineers.

In 1839 the Commissioner of Patents was given an appropriation of $1,000 for the purpose of publishing statistics of crops and such other information as seemed likely to promote agriculture. This

appropriation was gradually increased as the propaganda grew in popularity. Petitions for the appointment of a special commissioner of agriculture and the establishment of a bureau of agriculture began to appear in 1840, but the bureau was not established until 1862. The present Department of Agriculture, with a Secretary of Cabinet rank, was created in 1889.

It is not possible to read the memorials and petitions that were submitted to Congress at this time without noting a gradual change in their tone. The earlier ones, like those of Walter R. Johnson and Charles L. Fleischman (1838), urge Federal support of a school of applied science, because such an institution will prove a public benefactor by assuring better crops, increasing the public wealth, and making worthy citizens. Some of the documents depict the beneficent results that will follow when agriculture has become a learned profession on a par with law, medicine, and theology. In other words, these early documents justify Federal support of schools of agriculture on the ground of the service such schools may render to the Nation.

Later memorialists, like John S. Skinner (1848), "feel that they have a right to demand for enlightening this great pursuit *at least as much* of the public treasure as is given for the support of naval and military schools now maintained for improvement in the science of war." Since the farmers "possess not the means of concentrating and giving expression to their views that other classes enjoy and on all occasions *so promptly exercise*," it is fitting that Congress should do something for the farmer, too. This argument proved finally effective with Congress.

The growth of the demand for public support of training in applied science is evidenced not only by the increasing number of memorials to Congress, but also by the activities in a number of the States. The propaganda was not limited to agriculture, but included also the other industries. Thus, in New York, in response to repeated petitions from the American Institute, the State agricultural societies, and from individuals, the House committee on colleges, academies, and common schools reported favorably on September 11, 1847, an act "for procuring an experimental farm, and to establish a workshop for experimenting in mechanical operations and a school for the promotion of agriculture and mechanic arts." This act failed to become law. Each year saw the proposition revived in one form or another, only to be rejected. State legislatures, like Congress, seemed to regard these efforts as the work of educational enthusiasts and were not yet persuaded that the farmers themselves really wanted such a school.

This conception was in the main true. For in spite of the progress that had been made in both agriculture and the mechanic arts

and in spite of the fact that many of the leaders of the time clearly recognized the fundamental importance of production for national life, there still harbored in the background of the public mind, the fact that taxation for education in the useful arts was connected with training of the children of the poor and that manual skill in the mechanic arts was in some way incompatible with the social position of a gentlemen. It therefore seems reasonable to suppose that the slowness of the progress in this educational movement was due to this general social atmosphere which has until very recently been powerful enough to hamper effectively the development of vocational training. In spite of the conclusiveness of the practical argument for such training, it has required a century of struggle to elevate agriculture and the mechanic arts to the rank of a fashionable study. This fact suggests that educational reform is not so much a matter of the technique of the schools as it is of the social instincts and intuitions of the people.

The period from 1825 to 1860 was therefore marked by the rapid expansion of industry and invention, the reorganization of social structure from an agricultural to a manufacturing type, and the increase in the respect paid to manual work. Several schools were established by private benefactions as mentioned in the next chapter. It was thus a period of winning fortunes and opening up the resources of the country and of inauguration of the age of machinery.

Chapter V.

THE FOUNDATION OF TECHNICAL EDUCATION.

The first financial support for a school of practical arts came from private benefaction. In 1847, Abbott Lawrence gave $50,000 to Harvard for a school to encourage "the three great practical branches to which scientific education could be applied, viz: (1) Engineering, (2) mining, (3) manufacture of machinery." According to the deed of gift, "the sciences, investigating the properties and uses of materials employed in the arts; carpentry, masonry, architecture, and drawing are all studies which should be pursued in one or all of the principal divisions."

The same year that Lawrence made his bequest to Harvard (1847), the following notice appeared in the Yale catalog:

> Profs. Silliman and Norton have opened a laboratory on the college grounds for the purpose of practical instruction in the applications of science to the arts and agriculture.

Prof. Norton was permitted to hold the chair of agricultural chemistry on condition that he should draw no salary. The short course in agriculture given by Prof. Norton attracted more than 500 farmers to New Haven for scientific instruction. Until 1860 this entire enterprise, the beginning of true university work in America, was housed mainly in the chapel attic, when the gift of Joseph E. Sheffield furnished a home and a name.

In both these institutions the scientific school was kept distinct from the "college proper;" the scientific student lived in a different building, had lectures and recitations in different rooms, was instructed by different professors, and was graduated at a different time and place. Nay, whether it was that young men taking scientific studies were considered as ipso facto lost souls, or as having no souls to be saved at all, they were not admitted to the students' seats at chapel—they were practically held as of an inferior order.

A third independent movement for the creation of schools of applied science came to a climax at the end of this period in the founding of the Massachusetts Institute of Technology. The principles on which this school was founded were formulated by William Barton Rogers, its first president, in two pamphlets, "Objects and Plan of an Institute of Technology" (1861), and "Scope and Plan

of the School of Industrial Science" (1864). According to President Rogers—

> the productive talent of the community, as measured by its proficiency in the practical arts demands that *systematic training in the applied sciences* which can alone give to the industrial classes a sure mastery over the materials and processes with which they are concerned. Such a training has become indispensable to fit us for successful competition with other nations in the race of industrial activity in which we are so deeply interested.

In the institute there should be a "School of Industrial Science and Art" where—

> persons destined for any of the industrial pursuits might secure such training and instruction as would enable them to bring to their profession the increased efficiency due to enlarged views and a sure knowledge of fundamental principles, together with adequate practice in observation and experiment, and in the delineation of objects, processes and machinery.
>
> The teaching of science . . . is especially adapted to fulfill another, and in some respects a higher purpose by leading the thoughts of the practical student into those wide and elevated regions of reflection to which the study of nature's laws never fails to conduct the mind. Thus linking the daily details of his profession with the grander physical agencies around him, and with much of what is agreeable and ennobling in the contemplation of external things, it would insensibly elevate and refine his character and contribute to the cheerfulness as it aided the efficiency of his labours.

In putting this revolutionary doctrine into effect, it was inevitable that the habits and practices of the conventional college of the time should have been transferred to the new institution, for President Rogers had himself served 25 years as a college professor and all the members of the first faculty were men trained in standard colleges. For this reason, there seemed to be no incongruity in establishing an institute of technology with a faculty composed of men who, however progressive and high-minded they may have been, yet had no experience with engineering practice. Apparently it caused no misgivings to transfer the departments of mathematics, English, foreign languages and history bodily from the standard college to the new school and to require the prospective engineer to devote most of his time to these standardized subjects for two years.

It is to be noted that the origin of these early schools of applied science was totally different from that of schools of law and medicine. These latter were organized by practitioners as an outgrowth of the apprenticeship system; and they have always been controlled and maintained by men in active practice. But the schools of technology were organized by college professors who were eager to put science to use, but who lacked practical experience with industrial production.

The three schools that have been mentioned were privately endowed institutions. In the founding of State supported colleges of

practical arts the way was led by Michigan. The constitution of 1850 states that the legislature "shall as soon as practicable, provide for the establishment of an agricultural school." The school was finally opened in 1857. The prospectus says, "At the opening of the institution, a *System of Labor* and a *System of Instruction* must be adopted and they must be harmonized with each other." When the school was dedicated, May 13, 1857, Gov. Bingham declared that—

> one of the highest objects to be attained by the establishment of an agricultural college is to elevate and dignify the character of labor. This can only be attained by an increased amount of knowledge, by making the laborer intelligent, so that an active, enlightened thought shall acompany the hand in guiding the plow and in all the various operations of the field.

This "Michigan idea" is distinct from the movement that was actively agitated from 1820 to 1840 for the introduction of manual labor in literary institutions. The latter regarded manual labor as essential for "invigorating and preserving health, without any reference to pecuniary profit," and was replaced later by college athletics. Michigan held "the grand idea that self-sustaining labor can go hand in hand with mental culture and refinement of taste" when it is "inseparably connected with the acquirement of knowledge. Thus allied, employment should be a charm instead of a drudgery."

It is significant that the first president of the Michigan Agricultural College, Joseph C. Williams, who formulated the ideals of the institution, was brought up in Massachusetts and graduated from Harvard in 1831. After 25 years' experience in the West, he saw, as he tells us in his inaugural address, that —

> we have no guides, no precedents. We have to mark out the course of studies and the whole discipline and policy to be followed in the administration of the institution. There are numerous agricultural schools in Europe, but while an inspection would afford important vital suggestions, they would afford no models for us. The schools of Europe, in the nature of the case, must for the present be designed for the stewards, factors, and hirers of the soil, who use the laborers as serfs and instruments. In this country, the landlord, farmer, middleman, and laborer are united in the same man, the lord of his own acres, and by necessity he must have an education to suit his own fortunate condition.

The "Michigan idea" that manual labor is educative when it is inseparably connected with the acquisition of knowledge proved peculiarly appropriate to American conditions. It recognized that "the occupation of the farmer affords scope for thought" and utilized the "interest which studies and labor may be made to shed upon each other." Under these conditions "what students observe while at labor stimulates them to the study of principles" and the "pupil finds it to his educational advantage to work." On Saturdays, when labor is optional, "five-sixths of the students request it."

Because of its faithful adherence to these principles the Michigan Agricultural College became the leader in this field and an inspira-

tion to many other similar schools in the 30 years of experimentation that followed.

Although the agricultural societies in Massachusetts, New York, Maryland, North Carolina, Illinois, Iowa, and other States were vigorously discussing the subject and petitioning Congress and their State legislatures for funds for this purpose, Pennsylvania is the only other State in which an agricultural school supported by public funds was established before Congress gave serious attention to the matter. Here in 1854, the citizens of Center County raised $10,000, the State agricultural society subscribed an equal amount, and land was purchased for a school near Bellefonte. The State contributed $50,000 in 1857 and the institution opened its doors in 1859.

The first board of trustees explain that "the Farm School proposes to impart an education which is appropriate to the farmer—which educates his body to the *art*, as well as his mind to the *science* of farming." "Science, art, and labor must be combined" in an institution which "improves the mind of the agriculturist and trains his hands."

Dr. Evan Pugh, the first president, began his career as a blacksmith's apprentice. By dint of hard work he secured some elementary schooling and was able to spend four years abroad studying chemistry at Paris, Leipzig, Heidelberg, and Gottingen, where he took his Ph. D. degree. "Passionately fond of scientific research," especially in agricultural chemistry, he returned, enthusiastic over foreign school methods, to devote himself to the cause of agricultural education in America.

The aims of the new school are presented by Dr. Pugh under four heads:

First, as a purely educational institution, its course of instruction "not only affords the student the facts of science, but it disciplines his mind to habits of thought, and enables him fully to comprehend the abstract principles involved in the practical operations of life." Second, as a practical institution, the student must "be taught the practical applications in the field and laboratory of the principles he studies in the classroom; and manual labor is also necessary for the preservation of health and the maintenance of habits of industry." Third, as an experimental institution, "private laboratories, with means for investigation, will be fitted up for graduates of this or any other college in which to pursue prolonged, special scientific investigation." Fourth, as a means of protecting industrial interests, it will "diffuse a higher degree of intelligence and a more extended scientific knowledge among farmers" to protect them from "quacks, imposters, and ignorant empiricists."

This separation of the purely educational from the practical and the experimental was a foreign ideal that did not thrive in the environment to which it was transplanted. Being "taught the practical application in the field and laboratory of the principles studied in the classroom" did not furnish the stimulus given by the Michigan plan. Manual labor "for the preservation of health and the maintenance of habits of industry" was very unpopular with both faculty and students. After Dr. Pugh's untimely death in 1863 the force of his personal inspiration was gone, and the school rapidly became a "mere literary college." In 1880, a legislative committee made an investigation and the legislature voted—

to pay no more money to said Pennsylvania State College until it shall be satisfactorily shown . . . that the agricultural and mechanical interests of the State are receiving from such college actual benefits which are commensurate with the amount of money expended for its support and maintenance.

A reorganization "brought the college back into its legitimate pathway," and it has since prospered and grown strong, along with the other State college of agriculture and mechanic arts that followed the methods evolved from the Michigan idea.

The contributions of New York to this movement—namely, the subsidizing of the agricultural societies (1819), the Buel Report (1823), the Rensselaer Polytechnic (1824), and the American Institute exhibitions (1828)—have already been mentioned. While propaganda for the ideas thus expressed was continued with increasing enthusiasm, and although the governor's messages, the proceedings of the State Agricultural Society, the agricultural journals, and the legislative documents teem with appeals, petitions, memorials, and reports on this subject, nothing permanent was accomplished there until the founding of Cornell University in 1867.

Besides New York, Michigan, and Pennsylvania, two other States, Massachusetts and Illinois, played important parts in crystallizing the movement and securing financial support for it from the Federal Government. In 1850 the Massachusetts Legislature commissioned the Rev. Edward Hitchcock, president of Amherst College, to make a study of European agricultural schools. His report, presented the next year, is a mine of practical information concerning the methods of administration and instruction in foreign institutions of this kind. The chief conclusions of the report are:

Agricultural schools fail if they do not receive aid from the Government. Theory must be tested by practice. Professors of agriculture in colleges are not sufficient, but independent agricultural colleges are essential. At least one such superior institution is needed in each of our States. Agriculture should be taught in at least one academy in each county. A manual of agriculture for use in ele-

technic Institute to the standard categories of instruction,—mathematics, chemistry, physics, etc. But these standardized forms had no significance for agriculture, and therefore a special treatment and a new point of view were necessary. Had it not been for the imperative public demand and for the vision of a few leaders like Williams and Abbott in Michigan and Turner in Illinois agricultural education might have been stifled and the new point of view might never have embodied itself in institutions.

The original act of 1862 states that the leading object of these national land grant colleges—

shall be, without excluding other scientific and classical studies, and including military tactics, to teach such branches of learning as are related to agriculture and the mechanic arts in such manner as the legislatures of the States may respectively prescribe, in order to promote the liberal and practical education of the industrial classes in the several pursuits and professions of life.

Many different interpretations of this provision have been made and numerous educational ideas have been read into it. Mr. Morrill himself was often asked to define and explain it, but his replies were always general and diffuse. They indicate that his own conception changed as the institutions grew. Thus in 1857 he urged the establishment of these colleges because "the farmer and the mechanic require special schools and appropriate literature quite as much as any one of the so-called learned professions." But in 1880 he tells us that "the object of the law was not to injure any existing classical institutions, but to reenforce them and bring liberal culture within the reach of a much larger and unprovided for number of the industrial classes in every State." Still another interpretation is given to the bill ten years later when he says "they should be ready to offer all the learning demanded by any portion of the American people."

Mr. Morrill was not an educational expert. He felt keenly that there was some discrepancy between the educational needs of industry and the schooling supplied by the standard colleges. As an expert on ways and means, he devoted his energies to securing the financial backing required for a new venture in education. His eminent success in the undertaking has been justly recognized by attaching his name to this legislation, which has already proved of inestimable value to the Nation, and the end is not yet. These "Morrill Acts" furnished financial means, but did not define educational methods. They were clearly intended "to do something for the farmer" by furnishing funds with which to carry out the project of agricultural education without limiting the schools by a too detailed statement of the educational requirements. An adequate understanding of the educational meaning may be had only from a study of the ideas expressed in the propaganda which forced this

financial and administrative legislation. These ideas are traced in the foregoing pages. Their educational meaning is clearly summarized in the words of Professor Turner:

> The most natural and effectual mental discipline possible for any man arises from setting him to earnest and constant thought about the things he daily does, sees, and handles, and all their connected relations and interests.

It thus appears that by 1860 a number of schools for training in industrial arts had been actually established and the educational principle that must guide in all such enterprises had been clearly formulated. Efforts at public support had been rewarded by the passage of the Morrill Act. The foundations of a distinctively American system of vocational education had been laid in spite of the fact that widespread social sanction for this type of training had not yet been won. Progress in this movement was notably accelerated by the Civil War, which dissolved many old prejudices and made clear the importance of industrial production and tool power in the development of national strength.

Chapter VI.

THE DEVELOPMENT OF TECHNICAL EDUCATION.

After the Civil War, technical schools were established at a rapid rate. The four schools of 1860 increased to 17 by 1870, to 41 by 1871, to 70 by 1872, and to 85 by 1880. Now there are 126 engineering schools of college grade of which 46 are land-grant colleges operating under the Morrill Act, 44 are professional schools in universities, 20 are attached to colleges, and 16 are independent. In 1870 the number of graduates of technical schools numbered three per million population, now they number 43 per million. In 1870 only about one out of every nine practicing engineers was a college graduate. Now about half of the practicing engineers are college graduates.

This progress has not taken place at a uniform rate. In the 30 years from 1870 to 1900 increase in the number of engineering graduates per million population took place at the average rate of 0.5 per year. Since 1900 this increase has been at the rate of two per year, or four times as great.

The new institutions did not win public recognition for a number of years. Several efforts were made to increase the Federal endowment of the land-grant colleges but Congress could not be convinced that these schools had as yet justified their existence until 1887 when $15,000 a year was granted to each State for the support of an agricultural experiment station. In 1890, $15,000 a year was granted to each State for the support of its land-grant college. These grants have since been increased to $30,000 yearly for the agricultural experiment stations and $50,000 yearly for current expenses. Recently the Federal Government has recognized the importance of this type of work by the passage of the Smith-Hughes Acts which carry with them an ultimate appropriation of $14,000,000 a year for the further extension of vocational training under the direction of the Department of Agriculture and the Federal Board for Vocational Education. These bills extend for the Federal support to secondary education and are proving effective in infusing real life into the work of the lower schools.

The slow development of instruction in applied science from 1864 to 1894 is attributable in large measure to the opposition manifested

by the colleges, which sought to maintain the social traditions of the past. In spite of the fact that the fundamental courses were practically the same in both the colleges of liberal arts and the technological schools, the former assumed a very illiberal attitude toward the more practical forms of instruction. In the long run, however, the claims of the arts colleges for a vague and abstract culture and mental discipline were no match for the concrete achievements of science. Backed as it was by the fruits of its labors in the form of increased production on the farm, better conditions of living and more comfortable modes of transportation and communication, science finally achieved recognition in the public eye. Once this recognition had been achieved, agriculture and the mechanic arts became "liberal and fashionable studies" and their further progress was assured.

In the first half of this period, these schools specialized in ordinary college work and instruction in engineering and the mechanic arts. In these lines there had been established definite methods of procedure which were easy to follow and which did not conflict too violently with the conventional college programs. Mathematics, physics, chemistry, mechanics, foreign languages, English and history could be taught by the same methods that were prevalent in the regular colleges. Hence they would pass muster as furnishing the type of mental discipline which was considered to be the ultimate aim of college instruction. In agriculture, however, these standard courses were not appropriate for the simple reason that as ordinarily taught they had no obvious connection with agricultural pursuits.

About 1895, having won the social sanction that was necessary for their development, the agricultural colleges began to expand rapidly. The "Michigan idea," that a suitable combination of learning and labor would yield mental culture and refinement of taste as well as increased production and practical skill, now had opportunity to express itself on a wide scale. New courses designed to fulfil the implications of this idea were developed in agricultural chemistry, soil physics, botany, zoology, and animal husbandry. Short courses and extension work were organized to bring the new knowledge and culture home to the farmers. The number of students in agriculture increased from 3,000 in 1894 to 130,000 in 1914. Agricultural production soon showed the effects of this increased intelligence; larger and better crops were harvested, and State legislatures at once began to make more liberal appropriations for the support of these schools.

On the side of engineering and mechanic arts the schools developed in a less striking manner. Here the lack of connection between the class instruction and practical life was less obvious than in the case of agriculture so that the old habits that were carried over from the arts colleges in the methods of teaching these subjects were retained.

As new inventions were made and new fields of engineering developed, new courses of instruction were added and curicula were more and more specialized. At the beginning most of the engineering schools offered not more than four different curricula in what were then recognized as the standard branches of engineering. Now the schools offer more than 20 different curricula each specialized in some particular line. Then the student was required to carry only three or four subjects at a time, now he is often required to carry as many as 10 or 12. This process of accretion and specialization has resulted in curricula that are enormously congested and has loaded the student with an amount and a divesity of work that are more likely to confuse and mystify than to enlighten.

Throughout this phenomenal expansion of scientific activity and invention little attention was paid to methods of instruction. The fundamental conception embodied in the work of the early schools to the effect that engineering could best be taught by first drilling the student in theory and then showing him applications was consistently followed throughout. Until very recently no one seems to have thought of applying the "Michigan idea" or the principles enunciated by Turner to such subjects as mechanics, chemistry, physics, or electricity. In this regard, the general outline of the curriculum of to-day does not differ materially from that of the engineering curriculum that was introduced at Rensselaer in 1849. The methods of teaching the fundamental subjects of mathematics, physics, chemistry and mechanics are practically the same as those in use 50 years ago. Very little effort was also made to develop in engineering and the mechanic arts short courses and extension work.

Whether due to this lack of obvious connection between the instruction in the early engineering schools and daily life, or to the general conditions of engineering practice, the fact remains that the progress in schools of this sort is far less striking than it is in the schools of agriculture. The total number of students in engineering and mechanic arts in institutions of college grade increased from about 11,000 in 1894 to 33,000 in 1914.

For a number of years practicing engineers have felt that the instruction in colleges of engineering and mechanic arts was not organized to meet the demands of the profession in the most satisfactory manner. This feeling found expression in the study that was made of these schools by A. M. Wellington, editor of the Engineering News, in 1892, and in the foundation of the Society for the Promotion of Engineering Education at the World's Fair in 1893. The feeling of dissatisfaction thus expressed gradually grew, until in 1907 there was appointed by joint action of the Society for the Promotion of Engineering Education and the National Engineering

Societies a joint committee on engineering education to make a thoroughgoing study of this subject. This committee secured the cooperation of the Carnegie Foundation, which liberally undertook to bear the expense of making the study, the report of which has recently been issued.

The greater portion of this report is devoted to a detailed analysis of the existing conditions in engineering colleges, a definition of the problems connected with engineering education, and suggestions as to the practical methods of solving them. In the general summary in the last chapter it is pointed out that the engineering profession is practically unanimous in the opinion that personal qualifications such as character, judgment, efficiency, and understanding of men are of greater importance in determining a man's success in engineering work than his knowledge of engineering science and practice. Hence the general conclusion is reached that the technical instruction must be given in such a way as to encourage the development of these personal qualifications as well as to insure thorough mastery of the technical knowledge. In order to accomplish this, it is suggested that greater attention should be paid first to obtaining the right emotional attitude of the student toward his work and to inspiring him with enthusiasm that will make him labor eagerly to accomplish it; and, second, to training him in habits of perceiving relationships so that he may acquire the power of grasping the essential factors of any situation and of reorganizing them to achieve the end in view.

The report indicates in considerable detail how these two fundamental aims may be achieved in actual school administration. For example, it is pointed out that the right emotional attitude of the student may be fostered by a better system of testing and grading. Most students know that under present conditions college grades do not always measure real ability and therefore they have not the same respect for them that they have for the records of the athletic field, which are obviously measures of achievement. Then, too, the almost complete dissociation of the work of the first two years from engineering practice makes it difficult for the student to realize that he is making progress toward the attainment of his ambitions. Shop practice when aimed at mere acquisition of skill does not appeal to his constructive imagination or release his creative energy. In the matter of perceiving relationships it does not help him if subjects like mathematics, physics, and mechanics are segregated in separate departments among which there is no interchange of ideas and no cooperation. Throughout the entire work the total disregard of the fundamental question of the relations between values and costs deprives the instruction of its most powerful means of securing both enthusiasm and a perception of relationships.

This analysis indicates that the difficulty with education in engineering and the mechanic arts lies in its failure to understand and appreciate the meaning of the fundamental conception of technical training which was so clearly stated by Jonathan B. Turner in his campaign for the establishment of an industrial university in Illinois in 1853. Turner's statement is that the "most natural and effectual mental discipline possible for any man arises from setting him to earnest and constant thought about the things he daily does, sees, and handles, and all their connected relations and interests."

The realization of this principle in school work requires that the student be kept in constant touch with practical industrial work and that this work be used as the source of the problems he solves in the classroom and the laboratory. Every student should therefore take an active part in productive work in the industries, the municipal activities, and the business and commercial operations about the school, not for the sake of winning a livelihood or of acquiring manual skill and technical knowledge alone, but also for the sake of opening his eyes to the problems that inspire men to creative efforts and lead them to wider visions and fuller mastery of the difficulties of existence.

During the past 10 years a number of individuals and individual schools have been making experiments for the purpose of applying the Turner principle in their regular work. Thus the principle is being applied to the general organization of the curriculum in the experiments at the Universities of Cincinnati and Pittsburgh and at the Massachusetts Institute of Technology. At these schools students in the regular engineering courses are required to spend part of their time under the supervision of the school in industrial plants. Instructors from the school visit the plant regularly to discuss with the students their difficulties. Each student is given a list of questions with respect to each job and is required to find the answers from an analysis of his work as it progresses. He thus acquires technical knowledge and skill under real working conditions and at the same time is impelled to "earnest and constant thought about the things he daily does, sees, and handles."

Because the time schedule at these three schools is very different the identity of their purpose in this experiment is apt to be overlooked. In reality, however, their experiences indicate that the same principle can be applied effectively in a number of different ways. It is to be hoped that schools will not attempt to reduce these experiments to a standardized form, which would enable institutions to adopt the form mechanically without due appreciation of the spirit of the underlying principle.

Besides these more general experiments, a number of individual instructors are trying to express the Turner principle in their class

work. Thus Prof. R. M. Bird, at the University of Virginia, and Prof. Max Goetsch, at the University of Cincinnati, have independently developed courses in chemistry in which the laboratory work does not consist of the ordinary routine series of exercises but of a series of projects which the student must work out by himself. While these projects involve a great deal of chemical analysis they are in the main synthetic. The student is not asked to analyze a given sample of baking powder, but rather is told to make baking powder and determine whether it is better and cheaper than any he can buy. Besides training the student to solve problems, this sort of work also introduces the question of values and costs and necessitates the consideration of market conditions. In like manner Prof. C. C. More, of the University of Washington, at Seattle, is experimenting with a course in mechanics in which the deduction of principles follows a large experience in solving practical problems in which the principles are used. Prof. More is now cooperating with the Chief of Engineers of the United States Army in developing a similar course for the training of Army engineers. Hence even though an engineering school is not yet ready to apply the principle to the general organization of its curriculum, a great deal can be accomplished in individual courses.

The application of the principle is not limited to the technical studies. Some years ago Prof. Frank Aydelotte organized a new method of teaching English literature at the University of Indiana. He has since continued the experiment at the Massachusetts Institute of Technology. In this work literature is not presented in the ordinary manner as something to be appreciated for its beauty whether it has obvious relation to daily life or not. Here the student is first asked why he came to college, why he wishes to be an engineer, how an engineer differs from a mechanic, what relations exist between engineering and science or between science and literature. In order to take intelligent part in such a discussion, the student finds it desirable to read numerous essays by such men as Huxley, Mathew Arnold, Carlyle, and Lowell. Because his reading is thus obviously along lines of connected relations and interests, it becomes significant and is pursued with enthusiasm and a real motive. History and economics may readily be treated in the same way and with the same success.

The striking success of short courses and extension work in agriculture has induced several of the State universities to turn their attention to similar work in the mechanic arts. Although much has been accomplished, the movement has not prospered as a whole, largely because of the vague sentiment among engineering-school faculties that work of this sort was not of college grade and therefore outside

the scope of their activities. Just before the war, this attitude showed signs of weakening and excellent work was actually inaugurated by several of the leading schools. If the experience in agriculture is any criterion, it seems reasonable to expect that the successful development of this field will bring no less bountiful public support than has the similar work for the farmer. The public has always been ready to spend money on education, provided the results are tangible and clearly worth while.

It thus appears that before the war considerable progress had been made at particular schools and by individual teachers toward realizing the purpose for which the land-grant colleges and engineering schools were established. The progress, however, was slow, because it was still hampered by the old college traditions and by the vestiges of the feeling that manual labor is unbecoming to a gentleman. After the experiences of the war, it is to be hoped that these vestiges of an ancient conception of culture will have totally disappeared and that the school of agriculture and the mechanic arts will be able from henceforth to achieve in freedom and with enthusiastic social sanction the purpose for which they were established.

Chapter VII.

THE FUTURE OF AMERICAN EDUCATION.

At the opening of the great war the country was confronted with the problem of creating a military establishment of unprecedented magnitude and power. It was necessary not only to raise and train an army, but also to organize the national industries so as to equip, transport and supply that army at maximum speed. The unanimity and enthusiasm with which the country grappled with this colossal task was a marvelous demonstration of our latent idealism, our creative imagination and our inherent strength.

As the mobilization of our Army and industries progressed, relatively little difficulty was experienced in filling the positions which required technical training and experience of a high order. But serious shortages of men skilled in the mechanical trades were soon apparent. It was not possible to supply the various Army organizations with the requisite number of machinists, carpenters, blacksmiths, automobile repair men and other technicians without seriously crippling the essential industries on which the equipment and supplies for the Army depended. The number of technicians needed was so much greater than the existing supply that the regular training facilities at night schools, technical institutes and the Army's own training stations were wholly inadequate to meet the demands. Hence the Government was compelled to create a new training system of its own in order that mobilization might proceed.

This training system was inaugurated by the War Department, in February, 1918, by the appointment of the Committee on Education and Special Training. The functions of the committee were defined as follows:

> To study the needs of the various branches of the service for skilled men and technicians; to determine how such needs shall be met, whether by selective draft, special training in educational institutions or otherwise; to secure the cooperation of the educational institutions of the country and to represent the War Department in its relations with such institutions; to administer such plan of special training in colleges and schools as may be adopted.

The work of this committee was inaugurated by appealing to schools that had facilities for training in the mechanic arts to set up special short courses for soldiers. The men who took these courses

were inducted into the service by the Provost Marshal General and sent to the schools for two months of intensive military and technical training. During the eight months from April 6 to November 11, 130,000 men were trained at 147 schools in 67 different lines of technical work; 92,000 of these men had been assigned to Army organizations; about 70,000 had gone to France; and 38,000 were ready for delivery when the armistice was signed.

When the proposal was first made to the schools that they train unskilled men to be skilled mechanics in two months, it was universally declared that this could not be done. Yet because the country's need was great, many faculties patriotically agreed to attempt it. Since the time was short, it was not possible to furnish specific instruction as to the details of procedure. Instead, the trade specifications from the Army's occupational index, which define the duties and qualifications for every type of skilled workman required in the service, were supplied and each school was told to use its own ingenuity in training its quotas to meet those specifications. The suggestion was given that greater speed of training would be attained if instead of the ordinary methods of classified exercises a series of real jobs, each requiring thought and initiative on the part of the student were used.

This suggestion arose from the fact that in the Army all men are primarily soldiers for whom initiative, resourcefulness, quick thinking, ability to act intelligently in an emergency, and to utilize existing resources to accomplish unusual tasks are of the first importance. Therefore it seemed unwise to use the ordinary forms of vocational training which aimed primarily at securing dexterity in technical operations. The new system was designed to develop these personal qualifications of the soldier along with technical and manual skill.

Because of the novelty of this method of treatment, the schools took hold of the work with enthusiasm and there developed nearly as many different ways of training, for example, a blacksmith, as there were schools teaching blacksmithing. A system of active supervision was inaugurated under which each school was visited frequently by an expert in vocational training, and the most successful types of instruction in each line of work were carried by him from school to school. By this process of experimentation, supervision, and comparison of results, there was finally evolved a series of job sheets for each trade. These did not consist of directions for performing any operations, but rather of a series of questions, the answers to which must be worked out by the student on the actual job itself. In other words, the work was planned to realize as far as possible in practice the Turner principle of setting each man to constant and earnest thought about the thing he was doing.

The results achieved exceeded the fondest hopes of the committee. The universal testimony of the schools was that they had never seen students learn more thoroughly or with greater speed. The Army also was satisfied with the result as is evidenced by the fact that the committee was authorized to make contracts for the training of 220,000 more men during the winter of 1918–19. Had the war continued, 320,000 men would have been trained by June 30, 1919. A detailed report on this work has just been issued by the War Department.

While the success of this training must be attributed in considerable measure to the war spirit, there can be no doubt that the snap of the military training and discipline and the intrinsic interest of the work itself were also important elements in achieving the end sought. Certain it is that the military men agreed that the soldiers made as much progress in their military training during their two months' experience, in which only three hours per day was devoted to this purpose, as they did in the cantonments, where all their time was devoted to military work. In the same way many of the men who entered without skill with tools achieved in two months a degree of skill that was previously believed to require several years of training.

Before the work had progressed far another feature was added in the form of a course on the issues of the war. This was designed to furnish the soldiers the means of answering their many questions as to the reasons why this country was at war. There were occasional lectures, but in general the class time was occupied by discussion, in which the important facts concerning the origin of the war, the nature of the different Governments at war, the economic systems of the several nations, and their social conditions were freely argued. It was in no sense a propaganda for any one point of view, but an effort to supply information that would enable the men to answer their own questions to their own satisfaction. Later some 40,000 of the questions asked by the soldiers in the several schools were collected, classified, and organized under a number of leading heads with references to outside reading where the answers could be found. This was issued as a guide for conducting the course. It was designed to stimulate thought concerning the connected relations and interests of the things they were doing. It was evident that the students were enthusiastic about this work, because the classroom discussions were frequently continued in their barracks. Ninety per cent of the commanding officers heartily indorsed it, in spite of the fact that the time devoted to it was taken from the time allotted to military exercises.

Perhaps the most striking feature of this work was the fact that 130,000 men, who were selected by the draft machinery of the Provost

Marshal General without special reference to their technical skill, were received by the schools; and 130,000 men, each of whom was capable of some definite service, were delivered to the Army. This result was accomplished because every man was physically fit and because the attention of the school was focused first, upon defining accurately every job that had to be done; second, upon finding out what each man's special abilities were; third, upon allocating the jobs in acordance with the abilities; and fourth, upon developing those abilities to master the assigned jobs as rapidly as possible. Under this system progress was an individual matter. As soon as one job was finished, another was begun; and each man accomplished as many jobs as he was able to do well in two months. When the two months were finished, each man was placed as far as possible in a position in the service in accordance with his record of achievement at the school. To accomplish this, the schools used the same methods of sorting, rating, testing, and classifying men as were in use throughout the Army under the direction of the committee on classification of personnel.

In July, 1918, the plans for mobilization were extended and it became evident that great difficulty would be met in securing an adequate supply of commissioned officers to meet the requirements of the enlarged Army. Because the colleges had demonstrated their ability to train the kind of men that the Army needed, they were offered contracts for selecting and training the candidates for officers' training camps. The colleges gladly accepted this additional opportunity for national service. By order of the President a new division of the Army called the Students' Army Training Corps was created to serve as a reservoir for officer material. For convenience of administration, this corps was divided into a vocational and a collegiate section. Provision was made for the ready transfer of men from one section to the other or to officer training camps or to cantonments in accordance with their demonstrated abilities.

The Students' Army Training Corps did not have an opportunity to demonstrate its effectiveness. It was formally organized on October 1, but on account of the epidemic many of the schools were unable to begin work before October 20. It had then but three weeks of active life before the armistice was signed and demobilization became imperative.

The methods of training designed for the collegiate section of the Students' Army Training Corps were analogous to those used in the vocational work. The schools were given specifications as to the kind of knowledge required by Army officers in such subjects as map making and sketching, sanitation and hygiene, military administration and law. These first specifications were crude because of the brief time in which they had to be prepared. At the time of de-

mobilization experts were at work preparing more thorough specifications and gathering from army practice problems and subject matter that could be used advantageously in the training process. The underlying idea was to encourage the development of a system of training that would set each man to earnest and careful thought about the things he was doing.

Although the specifications of the courses were never completed, and although the time was too short to reduce the work to smooth running order, there were embodied in the organization of the Students' Army Training Corps several large conceptions which are of fundamental importance in the development of a national system of education. Prominent among these is the method of admission which was prepared but never used. Since admission to the Army is a privilege of every able-bodied citizen, it was obviously out of the question to limit admission to the Students' Army Training Corps by the ordinary methods of college entrance. On the other hand, some method of selecting those qualified to become officers was essential. Therefore, the committee devised a system consisting of a written application containing the past record of the student, a personal interview, and the standard Army intelligence test. Any boy who could qualify on these three grounds was to have been admitted without regard to his position in the ordinary scale of academic proficiency. If his academic achievement was not sufficient to enable him to carry the college work well, he could enter the vocational section first and be promoted as his abilities were demonstrated. With the assistance of the Committee on Classification of Personnel a system of selecting candidates for officers' training camps on the basis of demonstrated ability and of distributing the successful candidates among the several corps in accordance with their defined requirements was prepared but never used because of the demobilization of the corps.

By this system it was possible for any boy who was physically fit and over 18 years of age to enter the training system and continue until his commission was won provided he had the native ability and grit. Financial competency played no part because all the students were soldiers on active duty with pay and subsistence. No equally democratic system of selecting men for higher education has ever been established, and it is a matter of serious national concern that it could not be maintained permanently. Evidences are not wanting that some colleges may adopt similar systems of admission, but it will be a matter of great difficulty to solve the social and financial problems in a manner to guarantee the essential feature of this system, namely, education in accordance with ability without respect to family status or finances.

Again, the war-issues course, which has just been described in connection with the vocational training, was enlarged in scope and made a requirement of three class hours per week for every member of the Students' Army Training Corps. The proper administration of this course at any school required the cooperation of the departments of history, English, economics, sociology, and philosophy. Each of these contributed from its field of knowledge those elements that shed light upon the one problem of why we were at war. This unusual cooperation among departments has proved to be an inspiration for all concerned and nearly 300 of the 526 colleges that had units of the Students' Army Training Corps are continuing on their own initiative to give a course on modern, social, and economic problems designed after the model of the war-issues course.

Another fundamental conception of the Students' Army Training Corps was that of uniting all the institutions of higher education in a single enterprise for training for national service. For the time being the colleges forgot their individual differences. In the past academic standards, or denominational tenets, or self-culture have loomed large in the vision of many of the schools. It required a national crisis to focus their attention upon their one legitimate task of training for public usefulness. The 526 colleges were united by the Students' Army Training Corps into a single University of Uncle Sam, which constituted the first practical solution of the problem of a national university.

As has been shown in the previous sections of this bulletin, the country has been struggling since its origin to develop an educational system that expresses the American spirit. For 250 years progress toward the achievement of this ideal has been slow and halting. This Army training system may justly be regarded as the most complete realization that has yet been achieved of the education conceptions expressed in our national development and focussed in the Morrill legislation. While recent progress has been more rapid, especially in agriculture, the war experience has accelerated the movement and created a model that may safely serve as a guide for the future.

The two positive requirements of the Morrill legislation are "military tactics" and such branches of learning as will "promote the liberal and practical education of the industrial classes." As they were interpreted before the war both the "military tactics" and the "liberal and practical education" were administered in a manner well calculated to place fetters on individual initiative and creative imagination. The military training consisted mainly of close order drill and manual at arms with emphasis on implicit obedience to orders for three hours a week while on military duty. The liberal and practical education as a rule consisted of learning set lessons

and following directions in the execution of set exercises. Neither tended in any marked way to "set him to earnest and constant thought about the things he daily does, sees and handles" and hence both were in large measure incompatible with the American spirit.

In the war schools, conditions were very different. There the real jobs given challenged the ingenuity of the soldiers and released their creative energies in a struggle to win. The methods used were those the Nation has been struggling to secure ever since the Pilgrims landed on Plymouth Rock. The enthusiasm and the speed with which the men mastered the work together with the success of the training as shown by their records indicate that the methods used were compatible with the American spirit. Therefore those methods of training which proved so effective during the war may well be retained and perfected.

The conditions that must be fulfilled if the essentials of the war training are to be made permanent are these:

First, there must be some means of fostering the spirit of service. This was secured quickly in the war by the universal service law enforced in a thoroughly democratic manner through local boards. Perhaps some sort of required universal service may be needed to secure the same result in peace. Or perhaps it may be accomplished by a persistent campaign, like the food conservation campaign, carefully organized in every community and patiently sustained by intelligent cooperation of the schools. Congress will have to decide soon which method is to be followed.

In the second place, there must be some form of physical exercise and drill that result in fine physical set-up, good coordination, precision, promptness, self-discipline, and the instinctive habit of doing one's best under all conditions as a matter of course. During the war military training proved to be a most effective means for accomplishing these all important ends quickly and on a national scale. Perhaps there are other ways of securing this result, but the schools hitherto have not paid much attention to them, while military training makes the development of these qualities one of its first aims.

In the third place, the school work may be made far more impelling if it is organized in accordance with the Turner principle. The Army does this by analyzing carefully each job and leading a man to master it by a series of real questions, problems, and projects that the student must work out for himself. The activities of the household, the community, the State and the Nation may be treated effectively by this method. The humanities and the sciences lend themselves equally well to manipulation by it. When intelligently used it releases creative energy and fosters the development of initiative, resourcefulness, and freedom of thought. It is perhaps the most